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09/821,787	03/29/2001	Juergen Weichart	622/49809	8526

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EXAMINER	
MCDONALD, RODNEY GLENN	
ART UNIT	**PAPER NUMBER**
1753	19

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Please find below and/or attached an Office communication concerning this application or proceeding.

CCO 19

Office Action Summary	Application No. 09/821,787	Applicant(s) WEICHART, JUERGEN
	Examiner Rodney G. McDonald	Art Unit 1753

-- Th MAILING DATE of this communication appears on the cover sheet with the correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 02 September 2003.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 2-5 and 13-36 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 2-5 and 13-36 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 112

Claims 2-5 and 13-36 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 13 and 19 are indefinite because "thin" lacks basis for comparison.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 2, 3, 5, 13, 14, 19, 21, 24-26, 30-32 and 34-36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hull (U.S. Pat. 4,431,901) in view of Donohoe (U.S. Pat. 5,449,433).

Hull teach an induction plasma tube having a segmented, fluid-cooled internal radiation shield. (See Abstract)

FIGS. 1 through 8 illustrate four embodiments of the invention. The first embodiment, shown in FIGS. 1 and 2, generally includes a water-cooled copper induction coil 10 which surrounds a tubular quartz enclosure 12. The enclosure 12 extends upwardly from a water-cooled base 14 to an upper assembly 16 which includes a water supply manifold 18 and a water exhaust manifold 20. The supply and exhaust manifolds 18 and 20 include annular interior water channels 18a and 20a, which are

connected to exterior supply and exhaust water fittings 18b and 20b, respectively. Likewise, the base 14 includes annular interior water cooling channels 14a and 14b which are connected to one another and which are connected to exterior water supply and exhaust fittings 14c and 14d, respectively. The base 14 and the manifolds 18 and 20 are all annular so as to define a central cylindrical cavity 22 wherein a plasma may be formed by application of a high frequency electrical current to the induction coil 10. A quartz window 24 is mounted on top of the upper assembly 16 for viewing the plasma formed in the central cavity 22. (Column 5 lines 43-63)

The plasma tube further includes a plasma gas intake tube 26 at the top of the upper assembly 16. The intake tube 26 is used to admit an ionizable gas such as argon into the cavity 22, and for maintaining a flow of such a gas downwardly through the tube. The intake tube 26 may also be used to introduce various gaseous reactants into the cavity 22. The plasma tube further includes a set of four process gas intake tubes 28 which open into the lower end of the cavity 22 from the base 14. These tubes 28 are used when it is desired to introduce gaseous reactants into the plasma arc downstream from the induction coil 10. (Column 5 lines 64-68; Column 6 lines 1-7)

The plasma tube of FIGS. 1 and 2 further includes a segmented shield 30 which consists of twelve substantially identical thick-walled copper tubes 32. The tubes 32 are affixed at their upper ends to the water exhaust manifold 20 and extend downwardly therefrom along the inside surface of the tubular quartz enclosure 12. The tubes 32 are parallel to one another and are equally spaced from one another so as to form a generally tubular, segmented shield which protects the quartz enclosure 12 from most

of the heat and radiation emitted from a plasma located centrally in the cavity 22. The shield also reduces the amount of ionizing ultraviolet radiation emitted to the induction coil 10, thereby preventing electrical arcing between the windings of the coil 10. (Column 6 lines 8-22)

The plasma tube is typically operated at a frequency of 400 kHz to 5 MHz, at a power level of approximately 20 kW applied to the induction coil. (Column 6 lines 45-48)

FIG. 8 shows a fourth embodiment that is essentially the same as the embodiment of FIGS. 5-7, except that it lacks the boron nitride rods 56. The embodiment of FIG. 8 includes a shield 58 consisting of simple wedge-shaped segments 60, each having a bore 60a and water supply tube 62. This embodiment has been demonstrated to attain a sustainable temperature of approximately 15,000.degree. C. with an argon plasma at atmospheric pressure and a 400 kHz power supply. Even without the boron nitride shielding rods of the third embodiment, the shield of the fourth embodiment is sufficiently effective to permit the quartz enclosure to be touched manually immediately after the power is turned off. Also, it has been found that ordinary glass may be used to form the enclosure, rather than quartz, and yet permit attainment of plasma temperatures up to 15,000.degree. C. It is believed that the efficiency of this design is at least partially due to the narrow, relatively long gaps between the adjacent shield segments 60, which significantly limit the amount of radiation that can be transmitted from the plasma through the shield, but which do not significantly impair the electrical coupling between the coil and the plasma. (Column 8 lines 44-66)

Referring to FIG. 4, the plasma shield 38 of the second embodiment consists essentially of twelve shield segments 40 which are chevron-shaped in cross-section. Each segment 40 includes a central bore 40a and a water supply tube 42 located therein. Each segment 40 of the shield is thus cooled by means of the counterflow cooling system described above. The chevron cross-sectional shape of the segments 40 results in a partially interlocking arrangement between adjacent segments, wherein the gaps between the segments 40 are angled. This results in shielding of the quartz enclosure 12 and the coil 10 from direct radiation from the plasma in the cavity 22. (Column 7 lines 36-41)

The differences between Hull and the present claims is that the treatment of workpieces is not discussed and the distribution of the slits in the Faraday shield is not discussed.

Donohoe teach an apparatus for etching substrates utilizing an electrostatic shield. (See Abstract)

Donohoe teach in Fig. 3 a reactor of the present invention having the electrostatic shield in place. Fig.3 is the same as Fig. 2 with the exception of the electrostatic shield 17. The reactor has two loop antennas 11. The bell jar 10A is typically comprised of alumina or quartz or a similar dielectric which is removed relatively easily by the ion bombardment. The electrostatic shield 17 significantly decreases the capacitive coupling between the antenna 11 in the Mori source reactor (or the coils in another type of inductively coupled source) and the plasma. The capacitive coupling is decreased because the shield 17 protects or blocks the plasma

from the antenna's electric field. The electric field is responsible for the capacitive coupling. (Column 3 lines 8-17; Column 4 lines 11-18; Figs. 2 and 3)

The shield in the preferred embodiment is cylindrical in shape and fits over the bell jar 10A portion of the reactor 10. However, it is possible to use a shield 17 having a hemispherical shape (not shown), or alternatively, having a combination cylindrical/hemispherical shape (not shown). The shield 17 is disposed between the bell jar 10A and the antennae 11, where it functions to substantially prevent capacitive coupling between the antennae 11 and the plasma. (Column 4 lines 40-48)

Bands or strips of metal 17C are located between the slits 17A. The bands 17C have a width which is preferably larger than the width of the intervening slits 17A. The width of the bands or strips 17C will vary, depending upon the reactor parameters chosen. However, generally the width in the relative range of 1 cm is used for the metal bands 17C. The width of the intervening slits 17A tends to be a little smaller, and is generally in the range of 0.2 cm to 0.5 cm. (Column 4 lines 49-57)

The electrostatic shield 17 is comprised of a conductive material, preferably copper. Copper is preferred due to its cost and availability, and the ease with which it can be cut. (Column 4 lines 58-61)

The motivation utilizing a distribution of slits in an electrostatic shield during vacuum treatment is that it allows for prevention of capacitive coupling. (Column 2 lines 1-13)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Hull by utilizing a distribution of slits as taught by Donohoe because it allows for preventing capacitive coupling.

Claims 4, 15, 20, 22, 23, 27, 28 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hull in view of Donohoe as applied to claims 2, 3, 5, 13, 14, 19, 21, 24-26, 30-32 and 34-36 above, and further in view of Lai et al. (EP 0 801 413).

The differences not yet discussed is biasing the screen to a reference potential, utilizing two electrodes connected to a power source, utilizing a sputtering target and exchanging the screen body.

Lai et al. teach in Figure 5 an elevational cross section of an ICP reactor according to a presently preferred embodiment of the present invention. Besides implementing the double vertically slotted shield as discussed above, there are also several other innovative features in this design. An upper and lower adapter end flange are used to provide vacuum seals between the dielectric cylinder 24 and other portions of the reactor chamber. It is presently preferred to fabricate the adapters of aluminum. In Fig. 5 lower aluminum adapter flange 34 is shown sealing dielectric cylinder 24 to reactor chamber flange 36. Similarly the ***magnetron target*** assembly 38 forms a cover of the reactor chamber and includes magnetron target 40 and a ceramic insulator 42 to which upper aluminum adapter flange 32 seals dielectric cylinder 24. (Column 8 lines 12-27)

Aluminum adapter flanges 32, 34 also serve as electrical conductors to ground the shields 28, 30 to the chamber wall and may be used to aid in supporting the weight of the upper portion of the chamber assembly including the magnetron target assembly 38, if desired. The spacing between the two aluminum adapter flanges 32, 34 is determined by: (1) the outer ***ground*** shield 44 (***which serves as the return RF current path of the shields 28, 30*** and as a radiation shield for the RF coils 26 for purposes of reducing RF interference emitted to the environment); (2) by insulating standoffs between them; or (3) by the height of the dielectric cylinder 24. (Column 8 lines 28-39)

The Faraday-sputter shield structure 28, 30 essentially eliminate capacitive coupling between the RF coil and the plasma by providing an electrical short that prevents the capacitive component of the field caused by the RF coil from propagating to the inside of the Faraday-sputter shield. (Column 8 lines 54-59)

In order to form a plasma a radio frequency power source is generally used to provide power ***to one or more powered electrodes*** within a vacuum vessel containing a gas at a predetermined pressure in which the processing is to take place. (Column 1 lines 16-24)

Figure 1 shows biasing the substrate support with RF or DC power supply. (See Figure 1)

Figs. 2A-2E show shield configurations. (See Figs. 2A-2E)

Lai et al. teach replacing the shield after a certain time. (Column 9 lines 17-19)

The motivation for utilizing an electrostatic shield in a sputter apparatus is that it allows for blocking capacitive coupling between the RF antenna and the plasma inside the vacuum envelope. (Column 5 lines 11-13)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have biased the screen to a reference potential, utilized two electrodes connected to a power source, utilized a sputtering target and exchanged the screen body as taught by Lai et al. because it allows for capacitive coupling between the RF antenna and the plasma inside the vacuum envelope.

Claims 16-18 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lai et al. in view of Donohoe as applied to claims 2, 3, 5, 13, 14, 19, 21, 24-26, 30-32 and 34-36 above, and further in view of Nihei et al. (U.S. Pat. 4,999,096).

The differences not yet discussed is the controlling circuitry.

Nihei et al. teach in FIGS. 1 to 3, an embodiment of a thin film forming apparatus according to the present invention will be described. FIG. 3 diagrammatically shows waveforms used in the apparatus. In FIG. 3, PW denotes a sputter peak power (voltage), BW a sputter base power (voltage), PV a bias peak voltage, BV a bias base voltage, BW/PW a sputter base power ratio, T2/(T1+T2) a bias ratio, and (T1+T2) a switching period. Referring to FIG. 1, the thin film forming apparatus comprises a waveform-controlled sputter power source 2, a constant-voltage waveform-controlled reverse sputter power source 1, a bias current detecting sensor 4, a high frequency coil 5 for generating plasma, a bias current controlling high frequency power source 3 for controlling a bias current and enabling a stable discharge at a high vacuum region, a

vacuum chamber 17 within which film is formed, a substrate (e.g., Si substrate) 8, a target 6, insulators 10, and an optional waveform generator 9 made of a CPU and the like for setting sputter power, bias voltage and current waveforms under program control. (Column 4 lines 55-68; Column 5 lines 1-9)

With the thin film forming apparatus constructed as above, first the optional waveform generator 9 sets the sputter power waveform, bias (reverse sputter) waveform and bias current. These signals set by the optional waveform generator 9 are supplied to the waveform controlled sputter power source 2, constant-voltage waveform controlled reverse sputter power source 1 and bias current controlling high frequency power source 3. These power sources have feedback functions to maintain the waveforms as set, even under variation of loads or the like. Therefore, a change in any one set value will not affect the other values. A bias current control method which is one of the features of this invention will be described in detail. A bias current with the bias voltage PV set, e.g., at 150 V changes if for example a sputter power is changed. To avoid this, a bias current is detected by the bias current detecting sensor 4 and compared with a signal set by the optional waveform generator 9. Based on this comparison, the bias current is maintained at the set value by controlling a high frequency power supplied to the high frequency coil 5 by means of the bias current controlling high frequency power source 3. These operations serve to maintain stable discharge at a high vacuum region. (Column 5 lines 10-33)

Sine Nihei et al. teach control means for sensing the current which is made up of power and voltage it is believed to meet the voltage sensing limitation. (See Nihei et al. discussed above)

The motivation for utilizing control circuitry is that it allows for maintaining stable discharge. (Column 5 lines 32-33)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized controlling circuitry as taught by Nihei et al. because it allows for maintaining stable discharge.

Response to Arguments

Applicant's arguments filed September 2, 2003 have been fully considered but they are not persuasive.

RESPONSE TO THE ARGUMENTS:

In response to the argument that neither Hull nor Donohoe would have been combinable because Hull shows a shield inside the inductive apparatus while Donohoe show a shield outside an inductive chamber, it is argued that both Hull and Donohoe are concerned with controlling inductive coupling of energy into a chamber through a shield structure which would suggest that both reference's shield concepts are combinable. Hull recognize that a shield structure can be placed inside a chamber as required by Applicant. Donohoe recognize that a shield structure needs to have a specified slot density in order to control the electrical parameters of the inductive energy provided by the induction coil. The slot density that Donohoe teaches is required by Applicant. Donohoe also recognize that a shield structure can be a unit with joined slats (See

Figures 4 and 5 of Donohoe) also required by Applicant. Therefore, it would be obvious to one of ordinary skill in the art to have modified Hull by utilizing a shield structure with a specified slot density and operating as a unit because both references are related to controlling inductive coupling of energy into a chamber through a shield structure. (See Hull; Hull Figure 8 and Donohoe; Donohoe Figures 4 and 5 discussed above)

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rodney G. McDonald whose telephone number is 703-308-3807. The examiner can normally be reached on M- Th with Every other Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam X. Nguyen can be reached on 703-308-3322. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9310.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Rodney G. McDonald
Primary Examiner
Art Unit 1753

RM
November 6, 2003